

p-38

80014

(2)

AD-A269 383
[Barcode]

AFOSR-TB- 93 0676

Report No. UCB/ERL-90/4

JOINT SERVICES ELECTRONICS PROGRAM

FINAL REPORT
(Contract F49620-90-C-0029)
6 June 1990 - June 5, 1993)

Jeffrey Bokor and Michael A. Lieberman

DTIC
ELECTE
SEP 14 1993
S B D

31 July 1993

DISTRIBUTION STATEMENT A
Approved for public release
Distribution Unlimited

Prepared for:

93-21338
[Barcode]

Air Force Office of Scientific Research/NE
Bolling Air Force Base
Washington, D.C. 20332

93 9 14 045
ELECTRONICS RESEARCH LABORATORY
College of Engineering
University of California, Berkeley, CA 94720



REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
<small>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.</small>				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 31 Jul 1993	3. REPORT TYPE AND DATES COVERED Final 6 Jun 1990 5 Jun 1993	
4. TITLE AND SUBTITLE Joint Services Electronics Program Final Report			5. FUNDING NUMBERS F49620-90-C-0029	
6. AUTHOR(S) J. Bokor and M.A. Lieberman			7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Electronics Research Laboratory 253 Cory Hall University of California at Berkeley Berkeley, CA 94720	
8. PERFORMING ORGANIZATION REPORT NUMBER UCB/ERL-90/4			9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Office of Scientific Research/NE 110 Duncan Avenue Suite B115 Bolling Air Force Base, DC 20332-0001 Program Manager: Major Billy R. Smith, Jr., AFOSR/NE	
10. SPONSORING/MONITORING AGENCY REPORT NUMBER 2305 AS			11. SUPPLEMENTARY NOTES	
12a. DISTRIBUTION/AVAILABILITY STATEMENT APPROVED FOR PUBLIC RELEASE. DISTRIBUTION UNLIMITED.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This report summarizes the research activity supported by the Joint Services Electronics Program at the Electronics Research Laboratory for the period June 1990 to June 1993. It includes the Director's overview, a listing of principal investigators, degrees awarded to students and a list of publications and presentations. The research was organized into three themes during this period: Quantum Electronic Devices, Semiconductor Electronic Devices, and Neural Networks and Applications. Significant advances were made in all three areas. Under Quantum Electronic Devices considerable progress was made in overcoming the difficulties of realizing surface emitting optoelectronic devices. The novel growth technique of phase-locked epitaxy was developed which allowed for the improvement in control of layer thicknesses and improved performance of lasers. Under Semiconductor Electronic Devices, success was achieved in the deep sub-micron MOSFET program. Careful analysis of the fundamental issues that limit the continuation of the miniaturization of transistors has been an ongoing activity in this program. In the Neural Network and Applications Area, a prominent feature of the program has been the integration between theory and hardware. Revolutionary new architectures and algorithms for neural networks were investigated and tested on real-world applications, with particular attention given to applications of specific DOD interest.				
14. SUBJECT TERMS None			15. NUMBER OF PAGES 15	
16. PRICE CODE			17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	
18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED		19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED		20. LIMITATION OF ABSTRACT

DIRECTOR'S OVERVIEW

Over the period June 6, 1990 to June 5, 1993, the Joint Services Electronics Program (JSEP) has supported 15 faculty investigators, 46 students, and produced 88 publications in journals or conference proceedings, 14 Ph.D. degrees and 22 M.S. degrees.

The research has been organized into three themes: Quantum Electronic Devices, Semiconductor Electronic Devices, and Neural Networks and Applications. Significant advances were made in all three areas during the contract period.

Under Quantum Electronic Devices, the difficulties of realizing surface emitting optoelectronic devices are now being overcome. The novel growth technique of phase-locked epitaxy was developed, allowing ultra-precise control of layer thicknesses, and was used to fabricate vertical cavity surface emitting lasers, which produced up to 10 mW output -- the highest power reported for such lasers. A surface emitting second-harmonic generator was invented and shown to achieve a 100-fold improvement in second harmonic conversion efficiency by using asymmetric quantum wells for phase matching.

Under Semiconductor Electronic Devices, spectacular success has been achieved in the deep sub-micron MOSFET program. Careful analysis of the fundamental issues that limit the continuation of the miniaturization of transistors has been an ongoing activity. One issue is that as transistor dimensions shrink, the number of dopants and interface traps within the active area of the device becomes so small that statistical fluctuations in the random distribution of these can begin to have a measurable effect on device behavior. In an effort to investigate this issue, single interface traps in PMOSFETs were observed and characterized for the first time via the fluctuations in current through a $0.1\text{ }\mu\text{m} \times 0.3\text{ }\mu\text{m}$ transistor due to the filling and emptying of individual interface traps. An investigation of scalable device structures led to the identification of the SOI (silicon on insulator) device as the best opportunity for achieving functional devices below the $0.1\text{ }\mu\text{m}$ barrier. A determined effort at understanding and overcoming the challenges involved in designing and fabricating such devices at this unprecedented dimension culminated in the realization and characterization of silicon MOSFETs with a world record switching speed of only 12 psec. In spite of considerable effort in this area world-wide, the Berkeley record still stands as the fastest of any silicon technology, including advanced SiGe heterojunction bipolar.

In the Neural Network and Applications Area, a prominent feature of our program has been the integration between theory and hardware. We have investigated revolutionary new architectures and algorithms for neural networks, and tested them on real-world applications, with some particular attention given to applications of specific DoD interest. One new architecture is the cellular neural network (CNN). This is a deceptively simple concept, with rather complex theoretical ramifications. Its close analogy to the structure of the visual cortex has proven to be of great advantage in pattern recognition problems. Another architecture developed for signal processing-type applications involves a Wigner-Ville transform time-frequency technique. This scheme was investigated for classifying sonar returns from different objects at different angles of observations and achieved a 95% success rate, outperforming all other known classification algorithms.

This has been a period of great accomplishment and excitement in the JSEP program at Berkeley. We look forward to a continued productive relationship with JSEP.

LISTING OF PRINCIPAL INVESTIGATORS

Nathan Cheung
Leon Chua
T. Kenneth Gustafson
Chenming Hu
Ping Ko
Kam Lau
M. Lieberman
William Oldham
Abhiram Ranade
Alberto Sangiovanni-Vincentelli
Carlo Sequin
J. Stephen Smith
Shyh Wang
Eugene Wong
Avidesh Zakhor

STUDENTS PARTIALLY OR FULLY SUPPORTED BY JSEP: DEGREES AWARDED

Student	Degree	Year
Boothe, Bob	Ph.D.	93
Chan, James	M.S.	93
Chinrungrueng, Chedsada	Ph.D.	93
Chung, James	Ph.D.	90
Crounse, Kenneth	M.S.	91
Cruz-Moreno, Jose	M.S.	92
de Veciana, Gustavo	M.S.	90
Fong, Y.K.	Ph.D.	90
George, Peter	Ph.D.	90
Harshman, Patrick	M.S.	90
Hu, Limin	Ph.D.	90
Hung, Lawrence	M.S.	92
Kiang, Meng-Hsiung	M.S.	92
King, Chi-Chieh	M.S.	91
Lee, Angela	M.S.	91
Liang, Chunlin	Ph.D.	90
Liang, Guo Chun	Ph.D.	90
Lin, Hong	Ph.D.	92
Moon, J.E.	Ph.D.	90
Noriego-Asturias, Jorge	M.S.	92
Raghunath, M.T.	Ph.D.	93
Sin, C.K.	M.S.	90
Walker, Jeffrey	M.S.	90
Wann, Hsing-jen	M.S.	92
Wilson, Gordon	M.S.	90

11 Ph.D.'s and 14 M.S.'s

DTIC QUALITY INSPECTED 1

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

PUBLICATIONS/PAPERS/PRESENTATIONS

June 1990 - February 1991

J. Chen, P. Fang, P.K. Ko, and C. Hu, "Noise Overshoot at Drain Current Kink in SOI MOSFET," *1990 IEEE SOS/SOI Technology Conference Proceedings*, p. 40-41, October 2-4, 1990.

C. Chinrungrueng and C.H. Séquin, "Optimal Adaptive K-Means Algorithm with Dynamic Adjustment of Learning Rate," submitted to International Joint Conference on Neural Networks, Seattle, Washington, July 1991.

J. Chung, M.-C. Jeng, J.E. Moon, P.-K. Ko, and C. Hu, "Low-Voltage Hot-Electron Currents and Degradation in Deep-Submicrometer MOSFET's," *IEEE Transactions on Electron Devices*, Vol. 37, No. 7, pp. 1651-1657, July 1990. [Previously published in *27th Annual Proceedings, Reliability Physics*, 1989, Phoenix, Arizona.]

J.E. Chung, K.N. Quader, C.G. Sodini, P.K. Ko, and C. Hu, "The Effects of Hot-Electron Degradation on Analog MOSFET Performance," *Technical Digest of IEEE International Electron Devices Meeting*, pp. 553-556, December 1990.

R.D. Clay and C.H. Séquin, "Limiting Fault-Induced Output Errors in ANN's," submitted to International Joint Conference on Neural Networks, Seattle, Washington, July 1991.

G. de Veciana and A. Zakhor, "Neural Net Based Continuous Phase Modulation Receivers," submitted for publication to *IEEE Transactions on Communications*.

S.P. Dijaili, A. Dienes, and J.S. Smith, "ABCD Matrices for Dispersive Pulse Propagation," *IEEE Journal of Quantum Electronics*, Vol. 26, No. 6, pp. 1158-1164, June 1990.

S.P. Dijaili, J.M. Wiesenfeld, G. Raybon, C.A. Burrus, A. Dienes, J.S. Smith, J.R. Whinnery, "Cross Phase Modulation in a Semiconductor Laser Amplifier Determined by a Dispersive Technique," submitted to *Applied Physics Letters*.

P. Fang, K.K. Hung, P.K. Ko and C. Hu, "Characterizing a Single Hot-Electron-Induced Trap in Submicron MOSFET Using Random Telegraph Noise," *Digest of Technical Papers of Symposium on VLSI Technology*, Honolulu, Hawaii, pp. 37-38, June 1990.

P. George, P.K. Ko, C. Hu, "Model for Photo-Induced Long-Term Drain Current Transients in GaAs MESFETS," *Int. J. of Electronics*, Vol. 68, No. 5, pp. 721-728, October 1990.

P. George, K. Hui, P.K. Ko and C. Hu, "The Reduction of Backgating in GaAs MESFET's by Impact Ionization," *IEEE Electron Device Letters*, Vol. 11, No. 10, pp. 434-436, October 1990.

P.J. Harshman, K.J. Malloy, J. Walker, J.S. Smith, S. Wang, "MBE Growth of High Quality (111)B GaAs, GaInAs, and AlInAs," *Mat. Res. Soc. Symp. Proc.*, Vol. 198, pp. 265, 1990.

S. Hein and A. Zakhor, "Optimal Decoding for Data Acquisition Applications of Sigma Delta Modulators," presented at the 24th Asilomar Conference on Circuits and Systems, November 1990.

L. Hu, "A Novel Topology Control for Multihop Packet Radio Networks," will appear in *IEEE*

INFOCOM '91, April 7-11, 1991, Miami, Florida.

L. Hu, "Distributed Code Assignments for CDMA Packet Radio Networks," will appear in *IEEE INFOCOM '91*, April 7-11, 1991, Miami, Florida.

L. Hu, "Local Throughput Performance of Packet Radio Networks with Transmitting Power Control," will appear in *ICC '91*, Denver, Colorado, June 23-26, 1991.

M.-C. Jeng, J.E. Chung, P.-K. Ko, and C. Hu, "The Effects of Source/Drain Resistance on Deep Submicrometer Device Performance," *IEEE Transactions on Electron Devices*, Vol. 37, No. 11, pp. 2408-2410, November 1990.

A. Kramer, P.K. Ko, and A. Sangiovanni-Vincentelli, "Massively Parallel Analog Geometric Computation Using EEPROMS," abstract submitted to the Neural Networks for Computing Conference, Snowbird, Utah, April 1991.

A. Kramer, C. Sin, R. Chu, and P. Ko "A Highly Compact Linear Weight Function Based on the Use of EEPROMs", Abstract of Neural Networks for Computing Conference, Snowbird, Utah, May, 1990. (Not reported on previous contract.)

A. Kramer, C. Sin, R. Chu, and P. Ko, "Compact EEPROM-based Weight Functions," Proceedings of the 1990 IEEE Conference in *Neural Information Processing Systems 3*, San Mateo California: Morgan Kaufman, March, 1991.

G.C. Liang, X.H. Dai, and T. Van Duzer, "High T_c Superconductor Filters and Resonators," abstract, presented at the 1990 Applied Superconductivity Conference, Snowmass Village, Colorado, September 24-28, 1990.

G.C. Liang, D. Hebert, and T. Van Duzer, "Superconductive Digital Phase Shifters," abstract, presented at the 1990 Applied Superconductivity Conference, Snowmass Village, Colorado, September 24-28, 1990.

G.C. Liang, X.H. Dai, D.F. Hebert and T. Van Duzer, "High-Temperature Superconductor Resonators and Phase Shifters," to appear in *IEEE Transactions on Applied Superconductivity*, March, 1991.

H. Lin, S. Djaili and J.S. Smith, "Ultra High Speed Time Division Demultiplexing by Optical Parametric Interaction," presented at the Conference on Lasers and Electro-optics, Anaheim, California, May 1990. (Not reported on previous contract.)

X. Liu, H.P. Lee, and S. Wang, "Double-Heterostructure AlGaAs/GaAs Lasers Grown on the Mesas of Trenched Si Substrate by Molecular Beam Epitaxy," *Electronics Letters*, Vol. 26, No. 9, pp. 590-591, April 1990. (Not reported on previous contract.)

X. Liu, H.P. Lee, and S. Wang, "Polarization Characteristics of AlGaAs/GaAs Double-Heterostructure Lasers Grown on Si Substrates," *Appl. Phys. Lett.*, Vol. 57, No. 19, pp. 1955-1957, November 5, 1990.

R. Moazzami, C. Hu, and W.H. Shepherd, "A Ferroelectric DRAM Cell for High-Density NVRAM's," *IEEE Electron Device Letters*, Vol. 11, No. 10, pp. 454-456, October 1990 and

also, *1990 Symposium on VLSI Technology*, pp. 15-16, June 4-7, 1990, Honolulu.

R. Moazzami, C. Hu, and W.H. Shepherd, "Endurance Properties of Ferroelectric PZT Thin Films," *Technical Digest of IEEE International Electron Devices Meeting*, pp. 417-420, December 1990.

A. Oliveira and A. Sangiovanni-Vincentelli, "Empirical Learning of Boolean Functions Using Logic Synthesis," abstract of Neural Networks Computing Conference, Snowbird, Utah, April 1991. Extended Abstract submitted to Conference on Learning Theory, Santa Cruz, July 1991.

T.-C. Ong, P.-K. Ko, and C. Hu, "Hot-Carrier Current Modeling and Device Degradation in Surface-Channel p-MOSFET's," *IEEE Transactions on Electron Devices*, Vol. 37, No. 7, pp. 1658-1666, July 1990.

T.M. Parks, "Vector Quantization Code Book Design Using Neural Networks," UCB/ERL M90/111, December 3, 1990.

M.T. Raghunath and Abhiram Ranade, "A Simulation-Based Comparison of Interconnection Networks," *Proceedings of the 2nd IEEE Symposium on Parallel and Distributed Processing*, pp. 98-103, Dallas, Texas, December 9-13, 1990.

C.H. Séquin and R.D. Clay, "Fault Tolerance in Artificial Neural Networks," to appear as a chapter in a book entitled, *Neural Networks, Concepts, Applications and Implementations*, Vol. 4, Antognetti and Milutinovic, eds., Prentice Hall, 1991 (31 pages). Available as *Technical Report No. 90-031 from International Computer Science Institute, Berkeley*.

J.D. Walker, K. Malloy, S. Wang, and J.S. Smith, "Precision AlGaAs Bragg Reflectors Fabricated by Phase-Locked Epitaxy," published in the *Appl. Phys. Lett.*, 56(25), pp. 2493-2495, June 18, 1990.

S. Wang, "Nonlinear Effects in Guided-Wave Optics for Device Applications and Material Studies: Second Harmonic Generation Using Semiconductor Injection lasers," presented at the Topical Meeting on Solid State/Semiconductor Lasers, Beijing, China, June 18-21, 1990.

A. Zakhor, S. Hein, and K. Ibrahim, "New Properties of Sigma Delta Modulators with DC Inputs," submitted for publication to *IEEE Transactions on Communications*, November, 1990.

PUBLICATIONS/PAPERS/PRESENTATIONS

March 1991 - February 1992

F. Assaderaghi, J. Chen, P. Ko, and C. Hu, "Time Dependence of Fully Depleted SOI MOSFET's Subthreshold Current," *IEEE International SOI Conference Proceedings*, Vail, Colorado, October 1991, pp. 32-33.

F. Assaderaghi, J. Chen, R. Solomon, T.Y. Chan, P.K. Ko, and C. Hu, "Transient Behavior of Subthreshold Characteristics of Fully Depleted SOI MOSFET's," *IEEE Electron Device Letters*, Vol. 12, No. 10, October 1991.

J. Chan, "Low Energy Ion Beam Modification of AlN Thin Film for Insulated Gate Field Effect Transistors," to be presented at MRS Spring Meeting, San Francisco, California, April 27-May 1, 1992.

J. Chen, F. Assaderaghi, H. Wann, P. Ko, and C. Hu, "An Accurate Model of Thin Film SOI MOSFET Breakdown Voltage," *Technical Digest IEEE International Electron Devices Meeting*, Washington, D.C., December 1991, pp. 671-674.

J. Chen, P.K. Ko, and C. Hu, "Effects of the Field-Edge Transistor on SOI MOSFETS," *Proceedings of Technical Papers, 1991 International Symposium on VLSI Technology, Systems, and Applications*, Taipei, Taiwan, May 1991, pp. 219-223.

J. Chen, R. Solomon, T.Y. Chan, P.K. Ko, and C. Hu, "A CV Technique for Measuring Thin SOI Film Thickness," *IEEE Electron Device Letters*, Vol. 12, No. 8, August 1991, pp. 453-455.

J. Chen, K. Quader, P. Ko, and C. Hu, "Hot Electron Gate Current and Degradation in P-Channel SOI MOSFETs," *IEEE International SOI Conference Proceedings*, Vail, Colorado, October 1991, pp. 8-9.

J. Chen, A. Lee, P. Fang, P. Ko, C. Hu, R. Solomon, and T. Chan, "Interface Quality of SOI MOSFET's Reflected in Noise and Mobility," *IEEE International SOI Conference Proceedings*, Vail Colorado, October 1991, pp. 100-101.

C. Chinrungrueng and C. Séquin, "K-Means Competitive Learning for Non-Stationary Environments," *Proceedings of the International Joint Conference on Neural Networks in Singapore (IJCNN-91-Singapore)*, Vol. III, November, 1991, pp. 2703-2708.

C. Chinrungrueng and C.H. Séquin, "Optimal Adaptive K-Means Algorithm with Dynamic Adjustment of Learning Rate," International Computer Science Institute (ICSI), Berkeley, TR-91-017, 1991, March. Also presented at IEEE IJCNN-91, Seattle, July 1991.

J.E. Chung, P.K. Ko, and C. Hu, "A Model for Hot-Electron- Induced MOSFET Linear-Current Degradation Based on Mobility Reduction Due to Interface-State Generation," *IEEE Transactions on Electron Devices*, Vol. 38, No. 6, June 1991, pp. 1362-1370.

J.E. Chung, M.C. Jeng, J.E. Moon, P.K. Ko, and C. Hu, "Performance and Reliability Design Issues for Deep-Submicron MOSFET's," *IEEE Trans. on Electron Devices*, Vol. 38, No. 3, March 1991, pp. 545-554.

S.P. Dijaili, Wisenfeld, C.A. Burrus, A. Dienes, J.S. Smith, and J. R. Whinnery, "Cross-Phase

Modulation in a Semiconductor Laser Amplifier Determined by a Dispersive Technique," *IEEE Journal of Quantum Electronics*, Vol. 28, No. 1, January 1992.

P. Fang, K.K. Hang, P.K. Ko, and C. Hu, "Hot-Electron Induced Traps Studied Through the Random Telegraph Noise," *IEEE Electron Device Lett.*, Vol. 12, No. 6, June 1991, pp. 273-275.

P. George, P.K. Ko, and C. Hu, "The Influence of Substrate Compensation on Inter-Electrode Leakage and Back-Gating in GaAs MESFETs," *Solid State Electronics*, Vol. 34, No. 3, March 1991, pp. 233-252.

P.J. Harshman and S. Wang, "Investigation of (111) Strained-Layers: Growth, Photoluminescence, and Internal Electric Fields," accepted for publication *J. Appl. Phys.*

P.J. Harshman and S. Wang, "Asymmetric AlGaAs Quantum Wells for Second-Harmonic Generation and Quasi-Phase Matching of Visible Light in Surface Emitting Waveguides," to appear in *Appl. Phys. Lett.*, March, 1992.

C. Hegarty, J. Lee and C. Hu, "The Effect of Heavily-Implanted Surface Layers on Fowler-Nordheim Tunneling Currents," accepted by *Solid State Electronics*.

C. Hu, "A Migration Path of Future Silicon MOSFET," Keynote Address, *10th Symposium on Future Electron Devices* (MITI, Japan), Tokyo, Japan, October 1991, pp. 185-191.

A. Kramer, P.K. Ko and A. Sangiovanni-Vincentelli, "Massively Parallel Analog Geometric Computation Using EEPROMs," abstract for Neural Networks for Computing Conference, Snowbird, Utah, April 2-5, 1991.

F. Lari, and A. Zakhor, "Automatic Classification of Active Sonar Returns Using Time-Frequency Techniques," submitted to SPIE's 1992 International Symposium on Optical Applied Science and Engineering, San Diego, California, July 1992.

H. Lin and J.S. Smith, "Optical Time-Division Demultiplexing Using Second-Order-Optical Nonlinear Effects," *Appl. Phys. Lett.*, 59 (22), November 1991.

H. Lin and J.S. Smith, "Compensating Group Velocity Dispersion in Quantum Well Lasers," presented at the Engineering Foundation Conferences, High Speed/High Frequency Optoelectronics, Palm Coast, Florida, March, 1991, and in February, 1992, submitted for publication in *Appl. Phys. Lett.*

Z.H. Liu, J.H. Huang, J. Duster, P.K. Ko, C. Hu, M.C. Jeng, and Y.C. Cheng, "Threshold Voltage Modeling for Deep-Submicrometer Conventional LDD MOSFETs at 300K and 85K," *Proceedings of 1991 International Semiconductor Device Research Symposium*, Charlottesville, Virginia, December 4-6, 1991, pp. 411-414.

R. Moazzami, N. Akt, Y. Nissan-Cohen, W.H. Shepherd, M.P. Brassington, and C. Hu, "Impact of Polarization Relaxation on Ferroelectric Memory Performance," *1991 Symposium on VLSI Technology Digest of Technical Papers*, pp. 61-62, Oiso, Japan, May 1991.

J.E. Moon, C. Galewski, M. Wong, W.G. Oldham, P.K. Ko, and C. Hu, "A Deep-Submicrometer Elevated Source/Drain LDD Structure Fabricated Using Hot-Wall Epitaxy," *Proceedings*

Technical Papers, 1991 International Symposium on VLSI Technology, Systems, and Applications, Taipei, Taiwan, May 1991, pp. 117-121.

A.L. Oliveira and A. Sangiovanni-Vincentelli, "Learning Concepts by Synthesizing Minimal Threshold Gate Networks," *Proceedings of the Eighth International Workshop in Machine Learning*, Chicago, Illinois, June 1991.

A.L. Oliveira and A. Sangiovanni-Vincentelli, "LSAT: An Algorithm for the Synthesis of Threshold Gate Networks," 1991 International Conference in Computer Aided Design, Santa Clara, California, November 1991.

A.L. Oliveira and A. Sangiovanni-Vincentelli, "Synthesis of Minimal Multi-Level Networks," to be presented at Neural Networks for Computing Workshop, Snowbird, Utah, April 1992.

S. Parke, J. Moon, P. Nee, J. Huang, C. Hu, and P.K. Ko, "Gate-Induced Drain Leakage in LDD and Fully-Overlapped LDD MOSFETs," *1991 Symposium on VLSI Technology Digest of Technical Papers*, Oiso, Japan, May 1991, pp. 49-50.

E. Rosenbaum, Z. Liu, and C. Hu, "The Effects of Oxide Stress Waveform on MOSFET Performance," *IEEE Transactions on Electron Devices*, 1991, pp. 28.1.1-4.

C-K. Sin, A. Kramer, V. Hu, R. Chu and P.K. Ko, "EEPROM as an Analog Storage Device with Particular Applications in Neural Networks," *1992 IEEE Transactions on Electron Devices*, accepted for publication in June 1992 issue.

J.D. Walker, Dan Kutchta, and J.S. Smith, "Vertical-Cavity Surface Emitting Laser Diodes Fabricated by Phase-Locked Epitaxy," *Appl. Phys. Lett.*, Vol. 59, No. 17, pp. 2079-81, October, 1991.

PUBLICATIONS/PAPERS/PRESENTATIONS

March 1992 - June 1993

F. Assaderaghi, J. Chen, P.K. Ko and C. Hu, "Measurement of Electron and Hole Saturation Velocities in Silicon Inversion Layers Using SOI MOSFETs," *Proceedings of the IEEE SOI Conference*, p. 112, Oct. 1992.

F. Assaderaghi, F. Hui, S. Parke, J. Duster, P.K. Ko, C. Hu, "Study of Current Drive in Deep Sub-Micrometer SOI PMOSFET's," *Proc. of Technical Papers, 1993 IEEE International Symposium on VLSI Technology, Systems and Applications*, Taipei, Taiwan, May 12-14, 1993, pp. 232-236.

J.S. Chan, N.W. Cheung, and K.M. Yu, "Low Energy Ion Beam Modification of AlN_xO_y Thin Film for Insulated Gate Field Effect Transistors," *Mat. Res. Soc. Symp. Proc.*, Vol. 268, p. 377, 1992.

J.S. Chan, T.C. Fu, and N.W. Cheung, "Comparison of AlN Thin Films Deposited by RF Magnetron Sputtering and Ion-Assisted Molecular Beam Epitaxy," presented at the Spring MRS Meeting, San Francisco, California, April 12-16, 1993.

J. Chen, F. Assaderaghi, P. K. Ko, and C. Hu, "The Enhancement of Gate-Induced Drain Leakage(GIDL) Current in SOI MOSFET and its Impact on SOI Device Scaling," *Proceedings of the IEEE SOI Conference*, p. 84, Oct. 1992.

J. Chen, F. Assaderaghi, P.K. Ko, and C. Hu, "The Enhancement of GIDL Current in Short-Channel SOI MOSFET and its Application in Measuring Lateral Bipolar Current Gain β ," *IEEE Electron Device Letters*, Vol. 13, No. 11, p. 572, Nov. 1992.

J.C. Chen, Z. Liu, J.T. Krick, P.K. Ko, C. Hu, "Degradation of N_2 Annealed MOSFET Characteristics in Response to Dynamic Oxide Stressing," *IEEE Electron Device Letters*, Vol. 14, No. 15, May 1993, pp. 225-277.

J. Chen, S. Parke, J. King, F. Assaderaghi, P.K. Ko, and C. Hu, "A High Speed SOI Technology with 12/18ps Gate Delay Operating at 5V/1.5V," *Technical Digest of IEDM*, p. 35, Dec. 1992.

J. Chen, R. Solomon, T.Y. Chan, P.K. Ko, and C. Hu, "Threshold Voltage and C-V Characteristics of SOI MOSFET's Related to Si Film Thickness Variation on SIMOX Wafers," *Trans. Electron Devices*, Vol. 39, No. 10, p. 2346, Oct. 1992.

S. Chiang, R. Wang, T. Speers, J. McCollum, E. Hamdy, and C. Hu, "Conductive Channel in ONO Formed by Controlled Dielectric Breakdown," *1992 Symposium on VLSI Technology Digest of Technical Papers*, pp. 20-21.

C. Chinnrungrueng and C.H. Séquin, "Adaptive K-Means Algorithm with Error-Weighted Deviation Measure," presented at the 1993 International Conference on Neural Networks, San Francisco, California, March 1993.

Reed D. Clay and Carlo H. Séquin, "Fault Tolerance Training Improves Generalization and Robustness," *Proc. Int. Joint Conf. on Neural Networks*, pp. 1-769-774, Baltimore, Maryland.

June 1992.

K. Crounse, T. Roska, and L. Chua, "Image Halftoning with Cellular Neural Networks," *IEEE Transactions on Circuits and Systems-II: Analog and Digital Signal Processing, Special Issue on Cellular Neural Networks*, Mar. 1993, to appear.

J. Cruz and L. Chua, "An IC Diode for Chua's Circuit," *International Journal of Circuit Theory and Applications*, to appear.

S.P. Dijaili, J.M. Wiesenfeld, G. Raybon, C.A. Burrus, A. Dienes, J.S. Smith, and J.R. Whinnery, "Cross-Phase Modulation in a Semiconductor Laser Amplifier Determined by a Dispersive Technique," *IEEE Journal of Quantum Electronics*, Vol. 28, No. 1, pp. 141-150, January 1992. (This publication was not reported last year.)

P.J. Harshman and S. Wang, "Asymmetric AlGaAs Quantum Wells for Second-Harmonic Generation and Quasiphase Matching of Visible Light in Surface Emitting Waveguides," *Appl. Phys. Lett.*, Vol. 60 (11), pp. 1277-1279, March 16, 1992.

P.J. Harshman and S. Wang, "Investigation of (111) Strained-Layers: Growth, Photoluminescence, and Internal Electric Fields," *J. Appl. Phys.*, Vol. 71, pp. 5531, 1992.

C. Hu, "Interconnect Devices for Field Programmable Gate Array," **Invited Paper**, *Technical Digest International Electron Devices Meeting*, pp. 591-594, San Francisco, California, Dec. 1992.

S.C. Kan, D. Vassilovski, T.C. Wu, and K.Y. Lau, "Transport Limited Modulation Bandwidth of Quantum Well, Wire and Dot Lasers," in *Appl. Phys. Lett.*, 62, 2307 (1993).

S.C. Kan, T.C. Wu, D. Vassilovski and K.Y. Lau, "Semiclassical Transport Model of Quantum Well Laser Dynamics," presented at Conference on Lasers and Electrooptics (CLEO), Anaheim, 1992.

P.L. Kelley, O. Blum and T.K. Gustafson, "Radiative Renormalization Analysis of Optical Double Resonance," *Technical Digest of the Nonlinear Optics, Materials, Fundamentals and Applications Conference*, Maui, Hawaii, 1992 (August), paper, Tues 4. (Partially supported by JSEP).

D.M. Kuchta, J. Gamelin, J.D. Walker, J. Lin, K.Y. Lau, and J.S. Smith, "Relative Intensity Noise of Vertical Cavity Surface Emitting Lasers," submitted to *Applied Physics Letters*.

F. Lari and A. Zakhori, "Automatic Classification of Active Sonar Data Using Time Frequency Transforms," SPIE International Symposium on Applied Science and Engineering, San Diego, California, July 1992. Also presented at the IEEE Signal Processing Workshops on Time-Frequency and Time Scale Transforms, Vancouver, Canada, October 1992; also submitted for publication to *IEEE Transactions on Signal Processing*.

Z. Liu, C. Hu, J-H. Huang, T-Y. Chan, M-C. Jeng, P.K. Ko, and Y.C. Cheng, "Threshold Voltage Model for Deep-Submicrometer MOSFET's," *IEEE Transactions on Electron Devices*, Vol. 40, No. 1, January 1993.

Z. Liu, H-J. Wann, P. K. Ko, C. Hu, and Y.C. Cheng, "Effects of N₂O Anneal and Reoxidation on

Thermal Oxide Characteristics," *EDL-13*, No. 8, p. 402, Aug. 1992.

Z. Liu, J. Krick, H. Wann, P.K. Ko, C. Hu, and Y.C. Cheng, "The Effects of Furnace N_2O Anneal on MOSFETs," *Technical Digest of IEDM*, p. 625, Dec. 1992.

Z.H. Liu, H.J. Wann, P.K. Ko, C. Hu, and Y.C. Cheng, "Improvement of Charge Trapping Characteristics of N_2O -Annealed and Reoxidized N_2O -Annealed Thin Oxides," *EDL-13*, No. 10, p. 519, Oct. 1992.

R. Moazzami, and C. Hu, "A High-Quality Stacked Thermal/LPCVD Gate Oxide Technology for ULSI," *IEEE Electron Device Letters*, Vol. 14, No. 2, February 1993.

R. Moazzami, C. Hu, and W.H. Shepherd, "Electrical Characteristics of Ferroelectric PZT Thin Films for DRAM Applications," *IEEE Trans. Electron Devices*, Vol. 39, No. 9, pp. 2044-2049, Sept. 1992.

R. Moazzami and C. Hu, "Stress-Induced Current in Thin Silicon Dioxide Films," *Technical Digest International Electron Devices Meeting*, pp. 139-142, San Francisco, California, Dec. 1992.

A.L. Oliveira and Alberto Sangiovanni-Vincentelli, "What Can Boolean Networks Learn?" 1992 Computational Learning Theory and Natural Learning Systems Workshop, Madison, Wisconsin, August 1992.

A.L. Oliveira and Alberto Sangiovanni-Vincentelli, "Constructive Induction Using a Non-Greedy Strategy for Feature Selection," Ninth International Conference in Machine Learning, Scotland, United Kingdom, July 1992.

A.L. Oliveira and Alberto Sangiovanni-Vincentelli, "Synthesis of Minimal Multi-Level Networks," presented at the Neural Networks for Computing Workshop, Snowbird, Utah, April 1992.

S. Parke, F. Assaderaghi, J. Chen, C. King, C. Hu, and P.K. Ko, "A Versatile, SOI BiCMOS Technology with Complementary Lateral BJT's," *Technical Digest of IEDM*, p. 453, Dec. 1992.

S. Parke, C. Hu, and P. K. Ko, "Deep Sub-micron Bipolar-MOS Hybrid Transistors Fabricated on SIMOX," *Proceedings of the IEEE SOI Conference*, p. 82, Oct. 1992.

S.A. Parke, J. E. Moon, H.C. Wann, P. K. Ko, and C. Hu, "Design for Suppression of Gate-Induced Drain Leakage in LDD MOSFET's Using a Quasi-Two-Dimensional Analytical Model," *Trans. Electron Devices*, Vol. 39, No. 7, p. 1694, July 1992.

S. Parke, C. Hu, and P.K. Ko "Complementary, High-performance Lateral BJT's in a SIMOX C-BiCMOS Technology," *Proceedings of the IEEE SOI Conference*, p. 142, Oct. 1992.

S. Parke, C. Hu, and P.K. Ko, "A High-Performance Lateral Bipolar Transistor Fabricated on SIMOX," *EDL-14*, No. 1, p. 33, Jan. 1993.

M.T. Raghunath and Abhiram Ranade, "Customizing Interconnection Networks to Suit Packaging Hierarchies," *Technical Report UCB/ICSD-93-725*, Computer Science Division, University of California, Berkeley, California, January 1993.

M.T. Raghunath and Abhiram Ranade, "Fault-Tolerant Routing in Partitioned Butterfly Networks," submitted to the 1993 International Conference on Parallel Processing.

K. Schuegraf, C. King, and C. Hu, "Ultra-Thin Silicon Dioxide Leakage Current and Scaling Limit," *1992 Symposium on VLSI Technology Digest*, pp. 18-19, June 1992.

K.F. Schuegraf, C.C. King, C. Hu, "Impact of Polysilicon Depletion in Thin Oxide CMOS Technology," *Proc. of Technical Papers, 1993 IEEE International Symposium on VLSI Technology, Systems and Applications*, Taipei, Taiwan, May 12-14, 1993, pp. 86-90.

K. Schuegraf, C. Hu, "Oxide Breakdown Model for Very Low Voltages," *IEEE 1993 Symp. on VLSI Technology Digest of Tech. Papers*, May 1993, pp. 43-44.

B. Shi, T. Roska, and L. Chua, "Design of Linear Cellular Neural Networks for Motion Sensitive Filtering," *IEEE Transactions on Circuits and Systems--II: Analog and Digital Signal Processing, Special Issue on Cellular Neural Networks*, Mar. 1993, to appear.

C.K. Sin, A. Kramer, V. Hu, R.R. Chu, and P. K. Ko, "EEPROM as an Analog Storage Device, with Particular Applications in Neural Networks," *Trans. Electron Devices*, Vol. 39, No. 6, pp. 1410-1419, June 1992.

H. Wann, P.K. Ko, and C. Hu, "Gate-Induced Band-to-Band Tunneling Leakage Current in LDD MOSFETs," *Technical Digest of IEDM*, p. 147, Dec. 1992.

G.C. Wilson, D.M. Kuchta, J.D. Walker, and J.S. Smith, "Transverse Modes and Spatial Hole Burning in Vertical-Cavity Surface-Emitting Laser Diodes," submitted to *Applied Physics Letters*.

T.C. Wu, S.C. Kan, D. Vassilovski, and K.Y. Lau, "Influence of Separate-confinement Layer Bandstructure on the Transport-limited Modulation Bandwidth in Quantum Well Lasers," accepted for publication in *IEEE Photon. Tech. Lett.*

T.C. Wu, S. Kan, D. Vassilovski and K.Y. Lau, "On Reaching the K-Limited Bandwidth in Quantum Well Semiconductor Lasers," presented at the 13th International Semiconductor Laser Conference, Takamatsu, Japan (1992).

DEGREE THESES/PROJECTS

- B. Boothe, "Evaluation of Multithreading and Caching in Large Shared Memory Computers," Master's Thesis, University of California, Berkeley, July 1993.
- J. Chan, "Investigation of AlN as an Insulated-Gate and Wide Bandgap Semiconductor Material," M.S. Thesis, University of California, Berkeley, 1993.
- C. Chinrungrueng, "Evaluation of Heterogeneous Architectures for Artificial Neural Networks," Ph.D. Thesis, University of California, Berkeley, April 1993.
- J. Chung, "Performance and Reliability Design Issues for Deep-Submicrometer MOSFETs," Ph.D. Thesis, University of California, Berkeley, April 1990.
- K. Crounse, "Image Halftoning Using Cellular Neural Networks," Master's Thesis, University of California, Berkeley, December 1991.
- J. Cruz-Moreno, "A Cellular Neural Network Chip," Master's Thesis, University of California, Berkeley, December 1992.
- G. de Veciana, "Neural Net Based Continuous Phase Modulation Receivers," Master's Thesis, University of California, Berkeley, October 1990.
- Y.K. Fong, "Reliability of Electrostatic Discharge (ESD) Protection Devices and Circuits," Ph.D. Thesis, University of California, Berkeley, April 1990.
- P. George, "Device Models for the Gallium Arsenide MESFET," Ph.D. Thesis, University of California, Berkeley, April 1990.
- P. Harshman, "Study of Growth and Photoluminescence Characteristics of (111) Strained Layers," Master's Thesis, University of California, Berkeley, December 1990.
- L. Hu, "Distributed Algorithms for Packet Radio Networks," Ph.D. Thesis, University of California, Berkeley, September 1990.
- L. Hung, "A Programming Algorithm for Flash EPROM Analog Storage," Master's Thesis, University of California, Berkeley, December 1992.
- M. Kiang, "Utilizing Plasma Immersion Ion Implantation and Electroless Plating for Planarized Copper Metalization," Master's Thesis, University of California, Berkeley, May 1992.
- C. King, "Dielectric Based Antifuse for Neural Network Applications," Master's Thesis, University of California, Berkeley, December 1991.
- A. Lee, "A Domain Switching Distribution Model for Ferroelectric PZT Thin Films," Master's Thesis, University of California, Berkeley, December 1991.
- C. Liang, "Fabrication Technology and Device Modelling for Gallium Arsenide Metal-Semiconductor Field Effect Transistor," Ph.D. Thesis, University of California, Berkeley, September 1990.

G. Liang, "High-Temperature Superconductor Microwave Circuits," Ph.D. Thesis, University of California, Berkeley, November 1990.

H. Lin, "High Speed Devices for Optical Communications," Ph.D. Thesis, University of California, Berkeley, April 1992.

J.E. Moon, "Device Design for High-Speed Deep-Submicrometer MOS Technology," Ph.D. Thesis, University of California, Berkeley, September 1990.

J. Noriego-Asturias, "Random Telegraph Noise of P-Channel MOSFETs," Master's Thesis, University of California, Berkeley, May 1992.

M.T. Raghunath, "Network Design with Multilevel Packaging Hierarchies," Ph.D. Thesis, University of California, Berkeley, September 1993.

C.K. Sin, "EEPROM as an Analog Storage Element," Master's Thesis, University of California, Berkeley, September 1990.

J. Walker, "Precision AlGaAs Bragg Reflectors Fabricated by Phase-locked Epitaxy," Master's Thesis, University of California, Berkeley, June 1990.

H. Wann, "Modelling Gate-Induced Drain Leakage in LDD NMOSFETs," Master's Thesis, University of California, Berkeley, December 1992.

G. Wilson, "Modeblocking Semiconductor Lasers: A Discussion of Issues and A Computational Model," Master's Thesis, University of California, Berkeley, December 1990.